Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

FOREST RESEARCH NOTES

U.S.DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE
EXPERIMENT STATION *

STEPHEN N. WYCKOFF, Director

LIBRARY
RECEIVED
SEP 9 - 1959
U. S. DEPT. OF AGRICULTURE

No. 56

October 15, 1947

PINUS: PROPAGATION OF EXPERIMENTAL STOCK

By

A. R. Liddicoet, Research Assistant, and E. F. Kimbrough, Nurseryman

Breeding work at the Institute of Forest Genetics is directed toward the production of hybrid pines with increased growth or other desirable qualities. This work demands more refined nursery techniques than are required for the production of forest planting stock in great quantities and with few records. This Research Note, describing nursery techniques used at the Institute, is written in answer to many requests for such information and in the hope that it will be useful to others engaged in experimental work.

Adequate testing of hybrid trees presents some problems not encountered by breeders of annual crops. If progress in breeding long-lived trees is to be made within a reasonable length of time, the pine breeder must at the earliest possible moment select hybrid forms that show promise for further study. To this end, experimental designs are required that reveal small but significant differences in growth rate. The paired-row test; the paired-individual test; and the Latin-square test have been adopted.

These simple tests have proved adequate to detect differences that would be of economic importance. The nursery technique here described has been devised with the requirements for statistical testing in mind. It permits the use of a simple system of marking the rows and lines of seedlings in the bed so that pedigree and individual performance records may be kept with little difficulty. While statistical design is not discussed further, the reader will see that some of the practices here described were installed because of statistical requirements.

---

* MAINTAINED AT BERKELEY, CALIFORNIA, IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA.

The Institute of Forest Genetics is situated on a ridge 2½ miles east and above the town of Placerville, California, at an elevation of 2,700 feet The climate is mild and the rainfall moderate, the location being at the lower edge of the ponderosa pine belt of the Sierra Nevada. Climatic data from continuous observations during 1926-46 are as follows:

Mean annual temperature	58.7° F.
Mean annual amplitude of temperature	20.6° F.
Mean temperature for January	41.6° F
Average minimum temperature for January	34.5° F.
Mean temperature for July	77.5° F.
Average Maximum temperature for July	90.7° F.
Absolute minimum on record, on January 20, 1937	11.8° F.
Absolute maximum on record, on August 14, 1933	106.0° F.
Days with average temperature above 50° F., April 6 -- November 14	223
Average number of days without frost	334.8
Average number of growing days	244
Average annual precipitation	34.79 in.

86.5% of the precipitation occurs from November to April.
Less than 1/2 inch of rain falls from July 1 to October 1.

The site selected for the Institute nursery (fig. 1) is practically level and not shaded by buildings or large trees. The soil, Aiken clay loam, is free from any unusual amount of rocks and stumps and there is good drainage and an adequate amount of topsoil. When the soil is at proper moisture content, its texture permits balling of the stock or lifting bare-root stock.

NURSERY PREPARATION

In preparing the nursery site, all rocks, stumps, and large roots were removed. A tractor-drawn ripper was pulled across the land at 30-inch intervals with the shoe set to a depth of 18 inches. When the ripper struck a rock or stump that could not be uprooted a stake was set to mark the obstruction for later removal with dynamite or by other means. Smaller rocks were lifted out by the ripper or removed during later operations. Deep holes caused by rock and stump removal were back filled with subsoil to normal subsoil level, then dressed with topsoil to ground level. The nursery area was then disked and dragged with a box drag until an even grade was established.

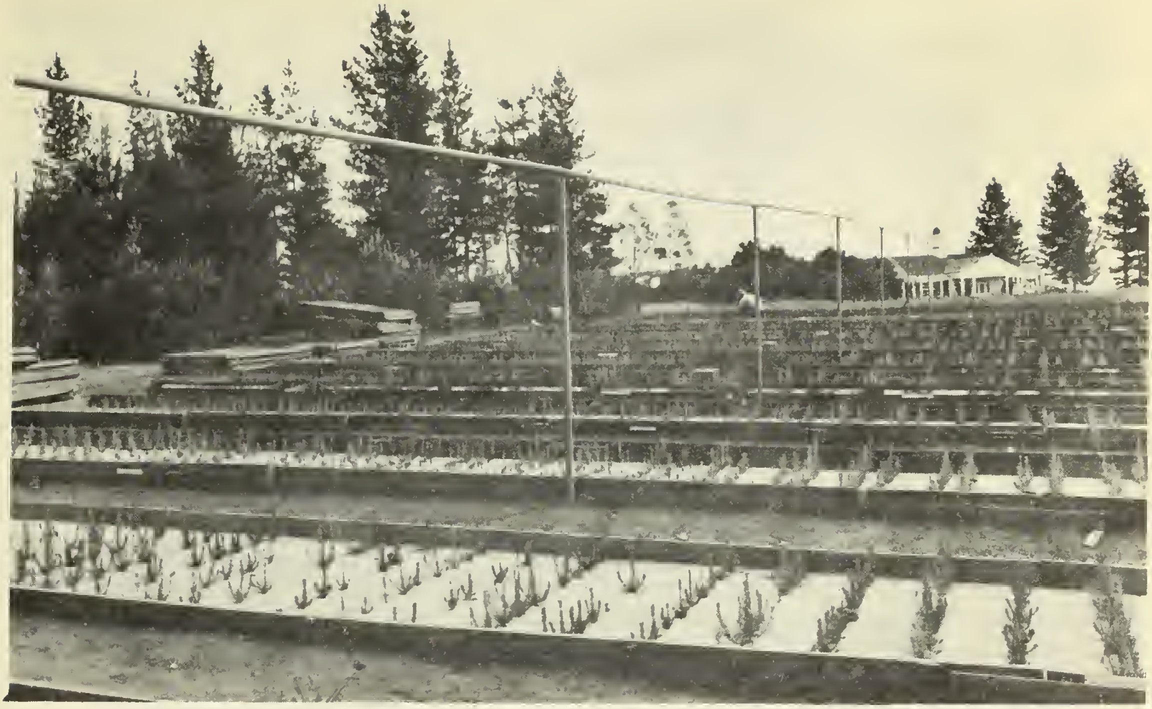

Figure 1.—Section of nursery, showing general layout of beds and overhead irrigation line. The young trees, starting their second season, were planted at 6-inch intervals in rows 12 inches apart. Each row in the bed is an experimental test plot, and already differences may be seen between rows of trees. Embossed aluminum labels on the frames identify each experiment. (Institute of Forest Genetics laboratory is in background)

A "March Brand" overhead sprinkling system was installed to conform with the plan of the nursery beds. The supply line is of 2-inch galvanized iron pipe buried 2 feet underground. The 1-inch sprinkling line is supported on upright pipes about 6 feet high and 15 feet apart. Every year the oscillators and saddles are inspected and repaired if necessary as there is considerable wear on some parts. During the winter months the whole system is drained to prevent freezing.

The only fertilizing that has been done has been with leaf mold and with turned-under cover crops of vetch and oats. A generous dressing of leaf mold has been worked into each new nursery area, and when the area is not in use a cover crop is planted each year. Although soil analyses show a deficiency of nitrogen and phosphorous in the soil, no corrective measures have been necessary in growing pine seedlings.

In experimental work, tree seedlings may be left in the seedbeds for as long as 7 years in some tests. A rest period of 3 years, or longer if possible, is allowed before the soil is again used for nursery beds.

Erosion control has not been a serious problem at the nursery, but contour ditches and basin listing were used for several years. A cover crop of vetch is sown each autumn and disked under about June 1 of the following year.

SEED STORAGE AND PREPARATION

No cold storage facilities have been provided for seeds although such facilities are desirable. The seeds are kept in air-tight containers in a concrete-walled basement, where the temperature ranges between 45° and 80° F. Under these conditions pine seeds stored for 15 years have given fair germination. The averate temperature is 61° F., and the average humidity is 67%. These figures are based on records from June 1941 to June 1942.

No soaking or scarifying of seeds is done; however, it has been found advantageous to stratify the seeds. This is done by packing them in a mixture of moist sand and peat moss, and holding the pack at a constant temperature of 40° F. Yellow pine seeds are held under these conditions for 70 days, and white pine seeds for 90 days.

The treatment induces practically complete germination of most species within a few days. When unstratified seeds are planted, germination extends over a period of several weeks. By insuring practically simultaneous germination of seeds, the treatment considerably reduces experimental error in studies of growth rates.

NURSERY BED LAYOUT

The nursery beds are 5 feet by 48 feet inside measurement. Because of the contour of the ground the beds are laid out with their long axes east and west. They are leveled across the width of the bed and have a slight grade from east to west. The sprinkler line runs north and south, equidistant between the ends of the beds so that the water is thrown slightly beyond the ends of the bed.

The older nursery beds are enclosed in frames made of 1" x 2" boards covered with hardware cloth. More recently 1" x 6" redwood has been used to frame the beds, (fig. 2) with hardware-cloth frames for top covers. This type of bed is less expensive both for material and installation costs. Such a bed is also easier to work with than the earlier form, requires less repair and upkeep, and affords adequate protection for young trees during the time of greatest need, the first year.

When the bed frames are installed they are checked to make sure that the side rails are level across the bed and have a slight grade for drainage lengthwise.

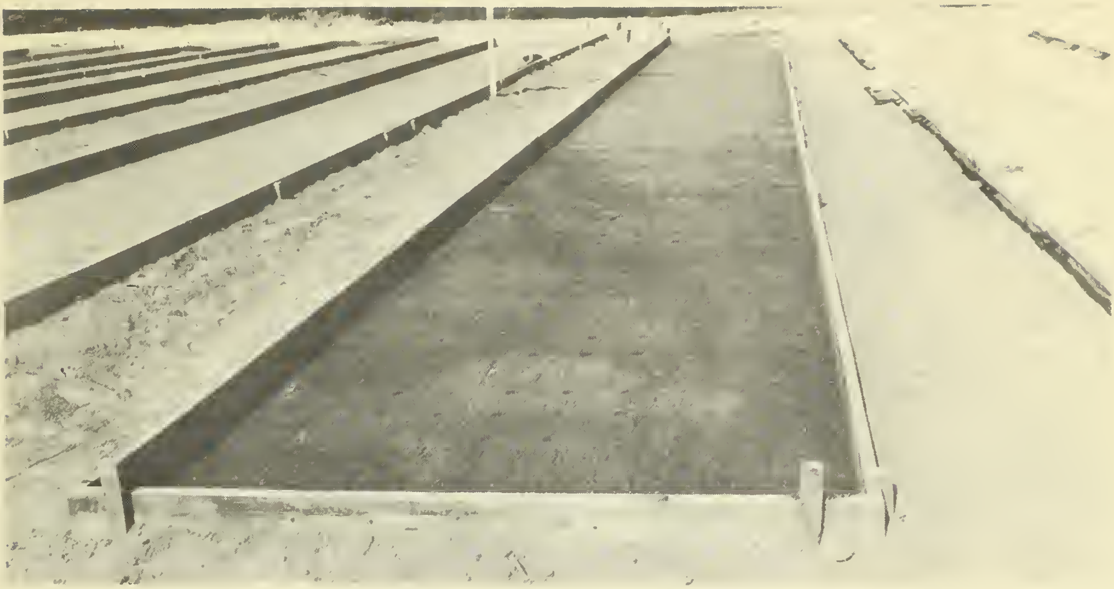

Figure 2.--Type of nursery bed used at the Institute ready for planting. Spots for planting seeds have been tamped in the sifted top soil with a special tamping board (Fig. 3, No. 4). The recently planted bed at the right is covered with screens to protect the seeds from birds and small animals

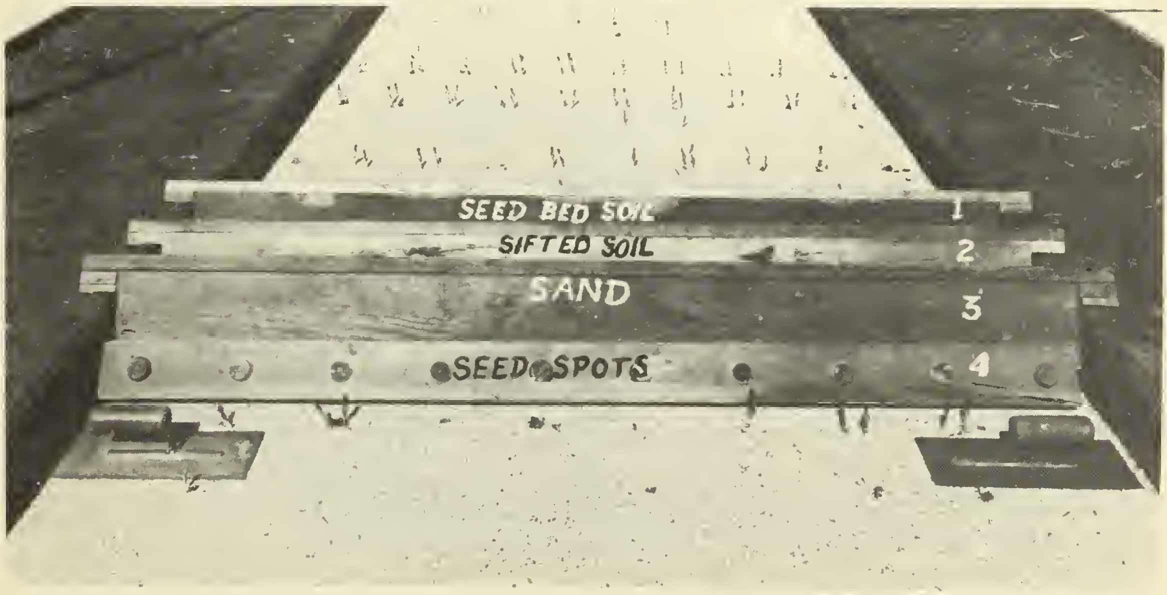

Figure 3.--Tools used in preparing and planting seedbeds. Numbers 1, 2, and 3 are guide boards, notched at the ends so that when they are dragged lengthwise of the bed, with the notches resting on the bed frame, they will strike of the soil to different depths. Number 4 is a tamping board with which seed spots are pressed into the soil. (Germination is in progress in this bed; when danger of loss is past the seedlings will be thinned to one per spot by random selection.)

SEEDBED PREPARATION

At planting time before the frames are installed, the ground is thoroughly pulverized to a depth of 6 to 8 inches with a Rototiller (a patented machine) If the ground is dry or hard it may be necessary to irrigate and disk the ground before the Rototiller can be operated satisfactorily It is customary here to prepare the soil in April and plant the seeds from the first to the middle of May

Rocks and trash brought to the surface by the Rototiller are removed. This is necessary each time the nursery is sown, for each year more rocks are brought to the surface by cultivation

After the frames are installed, the soil is raked to be sure it is evenly and finely pulverized The surface is then levelled 5 inches below the bed frame by dragging a guide board (fig 3) from end to end of the bed. Soft si[illegible]d soil is spread on the surface and levelled off 1/2 inch deep with a second guide board to provide a nesting for the seeds Seed spots are pressed into the dressed soil with a tamping board (fig 3), and the bed is ready for planting.

PLANTING

Seeds are removed from stratification just prior to sowing and are placed in envelopes marked to correspond with labels on the bed frames. This facilitates keeping an accurate record of each lot or experiment.

The seeds are carefully placed in the seed spots, or depressions made by the tamping board When more than one seed is used per spot, they are given the greatest interval possible within the spot Scarce hybrid seed are planted only one to the spot, but as many as five or six of the more abundant seed are planted to insure the establishment of a seedling at each spot, thus preserving the integrity of the experimental design

After seeds are placed the seed spot depression is filled with moist sifted soil and tamped firm with a plasterer s trowel to the level of the seed bed The bed is then dressed with 3/8 inch of clean river sand or decomposed granite and levelled with a third guide board Water is applied immediately with a hose and fine spray to keep the seeds moist

NURSERY CARE OF SEEDLINGS

Irrigation is required from the time the seeds are planted until the fall rains start. Frequency of irrigation depends on weather conditions, but since summer rains are rare in this locality, a fairly regular schedule can be worked out. Soil moisture changes are roughly checked by taking a handful of soil from beneath the sand dressing to see if it holds its shape when squeezed into a ball. If not, the soil is getting dry and the beds are irrigated.

Beds are irrigated when there is the least amount of wind possible, usually between 4 and 10 o'clock at night. Ordinarily, the seedbeds are irrigated two or three times each week. The sprinkling system is operated from 4 to 6 hours to secure adequate penetration of water. If irrigations do not penetrate sufficiently into the soil, a shallow root system, undesirable in pines, may result. A big advantage of the sprinkler system of irrigation is that it supplies the water slowly, allowing it to soak into the ground without run-off.

Unless the seasonal rains are very late, irrigation is reduced in September and discontinued about the middle of October in order to harden off the trees.

The yellow pines are irrigated for three years although there would be little loss if they were only watered for one year. The white pines, on the contrary, require three years or more of watering if they are to survive. White pines also require partial shade for the first three years. This is provided by screens made of laths fastened together with two lines of web belting.

Weeding is usually done by hand, but forceps are used at times. No other tools are used because it is desirable to maintain the sand dressing on the bed.

Thinning is done after 72 days, or sooner if it seems certain that the trees in the bed will survive. The spots are thinned to 2 (or 1) seedlings per spot the first year. Ultimately the seedlings are thinned to one per spot, those to be removed being selected at random to avoid bias. Thinning is done with a pair of grape shears, by clipping the young seedlings off at the surface of the sand.

The sand dressing, which is maintained as long as possible, reduces damping off — often troublesome when only soil is used. No other precaution against this common seedbed disease has been necessary. The most common insect pest is the aphid. These pests are controlled by nicotine sulfate. Other control measures are taken when needed as revealed by frequent inspections of the nursery.

PLANTATION PRACTICES

Most trees from this nursery are handled bare-root. When balled trees are desired, the split cylinder type of balling tool is used. Roots of bare-root stock are pruned to clean ends and convenient lengths, which is the only root pruning done. As much of the root system as possible is retained in this operation. The stock is kept covered with wet moss or burlap from the time it is dug until it is again planted to prevent drying.

Transplanting is usually done from the middle of November to the last of March, with the greatest activity in February and March. The season for digging depends on the time summer growth stops and spring growth starts. Pre-digging is not necessary here as the winter rains keep the ground soft enough for digging during the planting season.

On plantation sites, brush and obstructive rocks are removed and rodents are usually poisoned or trapped. But no attempt is made to clear out the weeds, small brush species, and rocks completely. Clearing work is restricted to the immediate vicinity of the hole where the new tree is to be planted. The hole is 18 inches deep and 14 inches in diameter. Subsoil dug from the hole is scattered, and topsoil from nearby is shoveled around the roots of the planted tree.

For most experimental planting an 8-foot spacing is used although this may be varied from 4 to 16 feet, depending on the purpose of the plantation and the abundance of planting stock. Care is taken to have the roots straightened out and the soil well tamped to eliminate air pockets. Transplanted trees are watered immediately after planting. In experimental plantings they are then watered at intervals of 3 weeks to a month for the first year and every month to 6 weeks during the second summer.

Although rodents are usually poisoned before an experimental planting is made, they soon return and constitute the most serious hazard to plantations in this locality. In addition to constant protection from rodents the plantation is protected from livestock by fencing and from insects by periodic inspections and necessary control measures